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TRANSACTIONS

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TRANSACTIONS OF THE SOCIETY OF TROPICAL MEDICINE AND HYGIENE.

MAY 16TH, 1919. VOLUME XIII. No. 1.

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SPECIAL NOTICE.

The volumes of the "Transactions" have hitherto commenced in the autumn and closed in the succeeding summer. To obviate the inconvenience caused by the "Transactions'" year not corresponding with the financial year, Vol. XII. has been closed with the February number, and this, the May number, is the first of a new volume, which will end with February or March, 1920.

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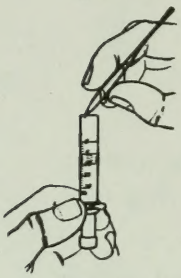

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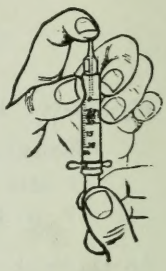

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Attention is drawn to the rule that Contributors of papers to the TRANSACTIONS receive 25 reprints free of charge, *provided they apply for these when sending the paper.*

Any communication for the Editor should be addressed to THE EDITOR of the TRANSACTIONS of the Society of Tropical Medicine and Hygiene, 11, Chandos Street, Cavendish Square, W. 1.

TRANSACTIONS

OF THE

SOCIETY OF TROPICAL MEDICINE AND HYGIENE.

MAY 16TH, 1919.

VOLUME XIII. No. 1.

Proceedings of a Meeting of the Society held on Friday, May 16th, 1919, at 5.30 p.m., at 11, Chandos Street, Cavendish Square, W. 1., Surgeon-General Sir DAVID BRUCE, K.C.B., F.R.S. (*President*), in the Chair.

FLY-SPRAYS.

BY PROFESSOR H. MAXWELL LEFROY.

Imperial College of Science, S. Kensington.

In July, 1915, a bottle containing a few ounces of a spirituous fluid was sent to me by the Army Medical Department, with the information that it was claimed to have curious properties with regard to fly destruction. It had been received from Mr. O'SULLIVAN BEARE, who had lately arrived in England from Brazil, and who learnt from the *Daily Mail* that flies were a factor in the transmission of disease in the war areas. Mr. O'SULLIVAN BEARE told me that in Brazil it was in general use, especially by travellers, who sprayed this liquid in the rest-houses where they stayed, with the result that flies, mosquitoes, and all other insects were exterminated and the traveller spent a peaceful night. He wished to be sent to Brazil to obtain immense quantities for the army; the only information he gave as to the nature of the liquid was that it consisted of an alcoholic tincture of a plant common in Brazil.

I had to test this liquid, and I was not then aware of any similar liquid against which to test it; but I decided to use a high-flash mineral oil, to which was added a small amount of essential oil to cover the smell. An equal number of flies was released in two rooms; an equal quantity of the tincture and of the oil was sprayed in each room; the results were that with the tincture practically all the flies came down in a peculiar condition of helplessness, while with the oil nearly all the flies came down either helpless or dead. If anything, the oil spray was the better of the two, and report was made accordingly. Mr. O'SULLIVAN BEARE furnished no further information as to the fluid, and, as no more was available, nothing more could be done then. But as the method of spraying small amounts of mineral oil did, to some extent, destroy flies, a large supply of

the oil was sent to the Mediterranean area, and this constitutes the first use known to me of the fly-spray method in the war.

This oil was an ordinary paraffin gas oil or light fuel oil, with a boiling point about 300°C. and a specific gravity of about 0·820; it is the grade of oil heavier than the burning oils, lighter than the lubricating oils, and to it was added 5 per cent. of citronella oil.

From August to October, 1915, the question of systematically working out tests of fly-sprays was gone into, and it was found that an extract of pyrethrum powder in spirit was an active fly-spray, even when much diluted.

The standard extract used eventually was one pound of pyrethrum powder to half a gallon of spirit, this being carefully percolated or slowly macerated, cold.

In Appendix I., a table is given of tests of a few extracts used with the results; it would be useless to tabulate all of these, and in Appendix II. is a list of the substances tested.

The ultimate outcome was this: a standard spirit tincture alone was good, if diluted in water up to about ten times; of other things tried, safrol was about the next best, working well in emulsion up to about 2 per cent., but the combination of pyrethrum extract with safrol was the best mixture. The final formula was:—Pyrethrum, 2lbs., spirit, 1 gall., safrol, 1 gall., soap, about 1oz., or enough to make the mixture emulsify in water. Dilute at 1 to 30 and spray.

The work that was done was closely followed by the Army Medical Department, and particularly by Major LELEAN, Professor of Hygiene at the Army Medical College. The fly-spray as described was adopted by the Army Medical Department, and first used in Salonica.

In testing fly-sprays, two methods were used: the first and usual one was to place a number of flies in a wire balloon trap as ordinarily used, and to spray into it 1 c.c. of the liquid; the flies were then observed at intervals and results noted. The second was to release a large number of flies in a small greenhouse and to spray 100 c.c. of the diluted liquid and to note the results.

In November, 1915, I was sent to India, and while there was sent to Mesopotamia to deal with flies. Before going, I arranged in Bombay for the making of the fly-spray, and also obtained a large quantity of a light lubricating oil (velocity spindle oil), to which was added citronella. The pyrethrum-safrol spray failed altogether in Mesopotamia; the oil spray was satisfactory up to a certain point. When I returned in December, 1916, to the Imperial College, experiments were started to ascertain if the ordinary fly-spray could be made suitable to hot climates, and I was assisted very ably in this by Mr. L. LLOYD. We rigged up the small greenhouse so that it could be heated to 115°F., and in that temperature we tested fly-sprays. We found that the addition of a small amount of castor oil, which is the only vegetable oil soluble in alcohol, made the normal pyrethrum-safrol spray effective and the final formula contained from ½ to 2 per cent. of castor oil. This was communicated to the Army Medical Department, and, I understand, was adopted.

During 1916, another fly-spray was used in the army, which was actually only the original oil-spray with peppermint oil instead of citronella. An alcoholic tincture, which the makers claim to be made to the formula of Mr. O'SULLIVAN BEARE, was also in use. I understand that this latter was used with success in Egypt, but, as it was used neat, the cost was high. The only other fly-spray known to me is an American one, which was sent to the Army Medical Department. It was effective but costly, a gallon selling in America for four dollars. It was stated by the makers to be an oil distilled from the needles of a pine.

The action of fly-sprays is not understood. It is known that pyrethrum contains an oil, and a complex organic substance which has been called pyrethro-toxic acid, the latter having an action on the nervous system of insects which is far more intense than that of any other known substance. In the fly-spray there is actually 1 part of pyrethrum in 100 parts by weight of water That 1 part of pyrethrum contains only a very small amount of the complex organic substance, far less than 1 per cent. But even if 1 per cent. were present, it would be working out at 1 in 10,000. Nicotine is used at 1 to 1,000, and that is one of the substances reckoned to be very

toxic to insects. Safrol is chemically the allyl. 3. 4. pyrocatechol-methylene-ether ($CH_2.O.O.C_6H_3.CH_2.CH.CH_2$.), allied to anisol and phenetol, both ethers in which a benzene and an ethyl or methyl group are joined by the oxygen atom, and all three are excessively toxic to insects. How these act on the insect is not known, but the probable action is that they combine extremely rapidly with compounds in the nervous system, and prevent further combination with oxygen, and so produce paralysis or inhibition of further chemical and physiological action.

Dr. BARGER, who investigated the chemical nature of the active substance in pyrethrum powder, isolated the active substance from petrol extraction of pyrethrum, but I am not aware of anything published by him. We tried a series of solvents to secure the maximum extraction from the powder, but though petrol is said by Dr. BARGER to be the best, spirit was used throughout, as petrol presented great difficulties in use.

Fly-sprays are useful under conditions where other methods of fly destruction are inapplicable. For rapidly clearing buildings, they are excellent. For the open they are useless. In the tropics particularly, where flies and mosquitoes are a burden, fly-sprays should have a great use.

The sprayers used have been the common type of tin sprayers, in which air is pumped through a narrow pipe, which opens across the opening of a pipe leading from a liquid container; as the air blows past it sucks up the liquid and atomises it. Used properly, a room or building can be very quickly and easily cleared of flies.

Since this work was completed, a great mass of further work has been done on the relationships of chemical structure of the molecule and toxic action on insects; and I have had occasion to use other substances than those named as fly-sprays. For this purpose, flies have been placed in wire balloons in a long glass box, 10 feet by 1 ft. by 1 ft., and a cubic centimetre of the liquid atomised in at one end. It was possible to get a measure of the toxicity by seeing whether the effect extended along to the whole 10 feet or only to part, or yet again, whether there was no effect. In Appendix III. the results are given of the compounds so tested. They are of interest and they shew that safrol is by no means the best substance and that a large field for research lies open. I am led to think that possibly quite new substances will be used as fly-sprays when this subject is further investigated, and I hope that ultimately we shall get substances as efficient as pyrethrum, which can be made pure, and in which we shall not have to depend on the small amount present in the plant. If so, then the use of fly-sprays should become more general even in England. In my own case, I spray a small amount of liquid in my kitchen in the hot summer weather at night. I can kill all the flies, and by doing this every few days I can check the plague of flies that otherwise abounds from July to September.

Particularly I commend the method for the tropics, where not only flies but mosquitoes, plant bugs, beetles, etc., are such a plague as soon as the lamps are lit. Pyrethrum and spirit can both be obtained, and if safrol is difficult, at least a spirit extract of pyrethrum can be made and sprayed with success. Probably when wider publicity comes, chemists in the tropics will make up and sell fly-sprays as well as supplying tin sprayers, and medical and sanitary officers will be able to see that the ingredients are available.

APPENDIX I.

I.—MUSCA IN BALLOONS.

A.

	No. of Strokes. (20 = 1 c.c.)	Results.
Pyr. Ext.	20 ... 1 hr. *l* ... 5 hrs. *l* ... 22 hrs. 2 *w* 40 *l*	... *l*
,, + H_2O 5% ...	20 ... 1 ,, *l* ... 5 ,, 2 *w* *l* ... 22 ,, 17 *w* 14 *l*	... *w l*
,, 50% + alc. (90%)...	20 ... 1 ,, *l* ... 5 ,, 5 *w* *l* ... 22 ,, 22 *w* 13 *l*	*w l*
,, 75% + H_2O 25% ...	20 ... — ... 5 ,, 7 *w* *l* ... 22 ,, 11 *w* 1 *l*	... *w*
,, 10% + H_2O 90% ...	20 ... 1 ,, 9*w* 5*l*... — ... 22 ,, 14 *w*	... *w*
,, 5% + H_2O 95% ...	20 ... — ... — ... 22 ,, 10 *w*	.. *w*

	No. of Strokes (20 = 1 c.c.)				Results
Oil	20	—	—	22 ,,	10 *d*	*d*
,, + cinnamic ald. 1%	20	—	—	22 ,,	16 *d*	*d*
,, + lavender oil 5%	20	—	—	22 ,,	15 *d*	*d*
,, + pine oil 5%	20	1 hr. 4′ 16*d*	—	22 ,,	4 *w* 16 *d*	*w d*
,, + iodoform 1%	20	—	—	22 ,,	18 *d*	*d*
Miscible oil, light	20	—	—	22 ,,	7 *d* 10 *w*	*w d*
Misc. heavy oil 20%, cinn. ald. 4%, H_2O 76%	20	—	—	22 ,,	7 *d*	*d*
Misc. heavy oil 10%, amyl alc. 10%, H_2O 80%	20	—	—	22 ,,	2 *t* 1 *d*	*t d*
Misc. Oil + 5%, fusel oil 20%	20	—	—	22 ,,	11 *w* 4 *d*	*w d*
Amyl alcohol 50%, H_2O 50%	—	—	—	22 ,,	6 *w*	*w*
,, 10%, solv. soap 10%, aq. 80%	—	—	—	22 ,,	10 *w*	*w*

w, Well. *d*, Dead. *t*, Alive, but unable to walk or fly.

B.

	24 hours.
10% miscible heavy oil, 10% of 1 in 25 petrol pyr. p.	1 *w* 8 *d*
Petrol ext. of *derris*	6 *w* 1 *t* 1 *d*
1 gr. pyr. p. in 25 c.c. oil in 225 c.c. aq.	1 *t* 4 *d*
2 grs. ,, 50 c.c. ,, 450 c.c. ,,	6 *d*
1 c.c. solv. soap, 1 c.c. oil, 8 c.c. aq.	4 *w*
1 c.c. solv. soap, 1 c.c. of 5 gr. pyr. p. in 25 c.c. oil, 8 c.c. aq.	1 *w* 6 *d*
1 gr. Bidwell 2, 10 c.c. petroleum	5 *w* 1 *d*
1 gr. ,, 3, 10 c.c. ,,	4 *w*

D.

1 c.c. solv. soap, 1 terpineol, 8 aq.	18 *d* 11 *w*
1 c.c. ,, 1 petroleum 8 aq.	0 *d*
1 c.c. ,, 1 petroleum ext., pyr. p. (1/10), 8 aq.	3 *d*
1 c.c. ,, 1 ,, pyr. p., 8 aq.	5 *w*
1 c.c. ,, 1 ,, pyr. p., 8 aq.	10 *w*
1 c.c. terpineol, 9 c.c. alcohol (90%)	4 *w* 3 *d*
5 c.c. (terpineol 1 alcohol (90%) 9), 5 (1 solv. soap, 1 petroleum, 8 aq.)	6 *w* 2 *d*
1 c.c. terpineol, 1 ext. Bidwell 3, 8 aq.	3 *w* 6 *d*
1 c.c. solv. soap, 1 ,, 2, 8 aq.	4 *w*
1 c.c. ,, 1 terpineol ext. pyr. powder, 20 aq.	4 *w* 1 *d*
Pyr. ext. 1. 2, turpentine 2, aq. 16.	all down, $\frac{1}{8}$ recover
,, ,, safrol, ,,	all down, die
,, ,, turpentine, ,,	,, ,, $\frac{1}{5}$ recover
Safrol 2, soft soap sol. 2, ,, 16.	,, ,, alive but torpid
,, 1, ,, ,, 1, ,, 8.	,, ,,
,, 1, ,, ,, 1, ,, 38,	,, ,,
,, 1, pyr. ext. 1, ,, 20,	,, ,,
,, 1, ,, 1, ,, 40,	,, ,,
,, 1, ,, 1, ,, 100,	,, ,,
,, 1, soap sol., 1, ,, 100,	,, ,,

	1 hour.	24 hours.	48 hours. *Dead.*	*Well.*
Cinol 1 in 10	down	$\frac{1}{2}$ up	120	19
Pyr. ext. + soap 1 in 10	,,	$\frac{1}{2}$ up	35	13
,, + ,, + cinn. ald 1 in 10	,,	$\frac{1}{2}$ up	100	38
Hellebore ext. 1 in 10	many down	all up	12	40
Acetic pyr. ext. 1 in 10	,,	$\frac{3}{4}$ up	all well	
Pyr. ext. + safrol 1 in 10	all down	all down	60	0
,, + ,, 1 in 20	,,	,,	90	0
,, + borax	down	$\frac{9}{10}$ up	104	12
Safrol and soap 1 in 40 each	,,	down	96	0
Misc. oil (light) + pyr. ext. 10% each	,,	$\frac{1}{2}$ up	62	30
Glycerine pyr. ext. in alc. 1 in 5	,,	$\frac{3}{4}$ up	33	25
Turpentine ext. 1, solv. soap 1, water 8	,,	$\frac{1}{2}$ up	25	11

APPENDIX I.—*Cont.*

	IMMEDIATE.	24 HOURS.	
		Dead.	*Well.*
Safrol 1 in 100	down ...	20	21
,, 1 in 60	,, ...	60	14
,, 1 in 50	,, ...	22	18
Safrol + pyr. ext. 1 in 100	,, ...	68	0
,, + ,, 1 in 60	,, ...	37	0
,, + ,, 1 in 50	,, ..	70	0

APPENDIX II.

Pyrethrum. — Powdered dried flower-heads of *Pyrethrum*, either Dalmatian or Japanese
Cinnamic aldehyde
Lavender oil
Pine oil
Iodoform
Miscible oil (light, heavy, or with fusel oil)
Amyl alcohol
Derris (MacDougall) powdered *derris* root
Mineral oil (A.D.O.)
Bidwell's powder, unknown plant
Terpineol
Acetone
Trichlorethylene
Solvent Soap = sulphonated castor oil
Petrol
Phenetol
Turpentine
Carbon bisulphide
Ethyl acetate
Formalin
Safrol
Anilin
Camphor
,, oil
Hellebore
Acetic Acid
Glycerine
Geraniol
Borax
Stavesacre
Piperazine
Brombenzene
Dichlorbenzene
Ethylthiocyanide
Oenanthol
Pseudocumol
Olive oil
Terpinhydrate
Picrotoxin
Canada balsam
Capsicum
Copaiba balsam
Balsam of Peru
,, of ginge

APPENDIX III.

DETERRENTS.

Paraffin	0	
Petroleum acid tar	0	
Acid formic	0	Excitement.
Chloroform	0	
Tetrachlorethane	2	
Bromoform	2	
Acetone oil, yellow	0	Escape.
,, brown	3	Down, die.
Acetamide	0	
Anethol	3	Down.
Aniseed oil	3	
,, terpene	3	Down, torpid in corners.
Phenetol	1	
Safrol	3	
Eugenol	1	Excitement.
Ethyl acetate	2	Excitement.
,, oxalate	1	Excitement.
Phorone	2	
Toluene	2	
Naptha crude	0	Excitement.
Soluble creosote	0	
Cresol, 95 per cent.	3	Mad, down.
Green tar oil	1·2	Effect not constant.
Light creosote, N.C.C.	2	
Benzyl chloride	2	
Nitro benzene	2	Drunk.
Aniline	2	Down.
Crude aniline oil	3	Down, no recovery.
Methyl salicylate	2	Excitement
Terebene opt.	0	
Citronella resin	2	Torpid, refuse food.
Light wood oil (Greenwood)	3	Down.
,, ,, (Cartvale)	3	
Wood creosote	2	
Dipentene	2	
Copal oil...	3	

APPENDIX III.—*Cont.*

Varnish fumes	3	
American fly-spray	3	Down.
Crude resin oil (Dussek)	2	Not down.
Refined ,, ,,	2	
Copaiba balsam	1	
Clayton's fluid	3	Down well.
Pyridine	2	Drunk.
,, crude	2	,,
Heavy tar bases	2	,,
Pyridine (Hardman)	2	Down.
Dippel oil		Drunk.
Nicotine, 98 per cent.	3	Mad, down.
Aniseed	2	
Carraway (Carvone)	2·1	
Origanum (Carvacrol)	2	
Cassia, 80 per cent. Cinn. aldehyde	2	
Cinnamon bark	2	
Eucalyptus globulus (cineol)	2	
Lavender (Esters + cineol)	1	
Verbena-citral	2	
Peppermint (menthol, menthane)	2	
Sassafras (safrol)	3	
Br. camphor (safrol)	3·2	
Thyme-thymol	2	
Thymene, residue of thyme	3	Down.
Pine oil	2	
Cajeput	1·2	
Essential oil resins	2	
Eucalyptol	2	Not dead.

The figures are the index of deterrent action :—

0 = no action. 1 = moderate. 2 = definite. 3 = extreme.

All substances with 3 are likely to be useful in fly-sprays.

Discussion.

Major E. E. Austen: May I be allowed to congratulate Professor Maxwell Lefroy on the painstaking investigations of which he has just given us an account? It is very evident that an enormous amount of work has been done, and that the results of such an extensive series of experiments are bound to be extremely valuable. I am not quite clear whether, in his researches, Professor Lefroy was envisaging the needs of troops in the field or of civil populations in ordinary times of peace. The two cases are of course totally different. One's thoughts are still almost inevitably coloured by the events of the last four and a half years, and it is as yet a little difficult to dissociate oneself from war, and think solely of a civil community. While I can quite imagine an effective fly-spray being of the greatest use in a town or village, or even under conditions which obtain at a military base in time of war, I am bound to say that such experiments as I have made in Mudros, Sinai and Palestine corroborated what Professor Lefroy told us, and pointed to the conclusion that the spraying method, as a means of fly-control, is practically useless in the field, at any rate in warm climates. The fluid used was Hepple's army spray, which I believe is identical with the alcoholic extract of pyrethrum, plus safrol, spoken of by Professor Lefroy. Apart from the difficulty—by no means a negligible one when lines of communication are long—of getting sprayers and fluid to spots at which they are wanted, and in addition to the apparent lack of killing power in the fluid itself, it was found that, in the field, flies in hot weather do not afford good "targets" for the sprayer. That is to say, until the nights begin to get cool, the insects do not usually enter tents and bivouac shelters in numbers sufficient to make the use of a sprayer worth while, even assuming the efficiency of the fluid used. So far at any rate as the E.E.F. was concerned, results shewed that infinitely the best method

of fly-control was the prevention of fly-breeding and fly-contamination, ensured by a fly-proof latrine-system, coupled with the prompt incineration of human excreta and camp refuse, and properly controlled spreading of horse-line manure. Wherever possible, these methods were supplemented by the use of poisoned bait (arsenite of soda, or formalin). It must be admitted, however, that poisoned bait of proved efficacy in one locality may be a total failure in another, or under a different set of conditions. Thus arsenite of soda, though very effective at Rouen, in June, 1915, was completely useless at Mudros in October of the same year, even with the addition of double the normal amount of sugar.

There is just one question which I should like to put to Professor LEFROY, and in asking it I need scarcely say that I am actuated solely by a desire for information. At Rouen, in June, 1915, pyrethrum powder, diffused through the air in quantity sufficient to produce a colourable though faint imitation of a London fog, was found absolutely effective in destroying every single fly inside a closed Aylwin hut. The method was tried night after night with complete success. This being so, why is it considered necessary to go to the trouble of making an extract of the powder, for use in a sprayer?

Lieut.-Col. A. BALFOUR: I am anxious to obtain some information from Professor LEFROY because I am not clear if the castor oil of which he spoke as rendering sprays more effective in the tropics is added to the light fuel oil-spray or to the pyrethrum-safrol spray. I believe it is to the latter, but Professor LEFROY did not seem to me quite clear upon this point. I have recently had to write something about preventive measures for flies, and have come across accounts of "Cinol" fly spray and of the "Osbeer" fly-spray, which is also called flybane. If Professor LEFROY can enlighten me as regards their composition I should be grateful. I may say that I have seen gallons of fly-spray wasted in several parts of the tropical world, but I have also seen it usefully employed, as, for example, in the dug-out of a certain General at Cape Helles, where, shortly after the arrival of Army fly-spray on the Gallipoli peninsula, we spent a profitable evening killing flies by means of one of the tin Hepple-sprays which Professor LEFROY mentioned as suitable for indoor use.

I quite agree with Professor LEFROY and Major AUSTEN that fly-sprays are of little use in the open, but I have seen them do some good. I remember seeing a considerable number of flies killed by what was probably the light fuel oil-spray in an open courtyard at Amara. This, however, happened in November, when the conditions were comparatively cool, at least for Mesopotamia.

I should like to ask Professor LEFROY whether the efficiency of this addition of castor oil has been actually tried in hot climates, or whether it has merely been tested experimentally in this country.

Mr. A. W. G. POMEROY: In reference to the point brought forward by Major AUSTEN, that in the field under war conditions in the tropics, fly-sprays were generally found to be an impracticable method of control, I beg to agree entirely.

In Dar-es-Salaam, East Africa, where I was working on fly control for some time, the greatest centres of attraction for flies were such places as supply dumps, canteen stores, butcheries and remount depôts.

Spraying in the first two instances was abandoned owing to the damage real or fancied which might occur to the stores from the chemicals used, especially on stores such as dates and potatoes, of which there were large quantities.

In the other two main centres there was never found a sufficient percentage of flies congregated in one place to form a suitable target, so that they would not be decreased by this method to the same degree as by the more simple one of destruction in the early stages.

The activity of flies in the tropics I have found to be very different from their usual activity in the temperate climates.

Many times I have found flies very active at night, and even at two in the morning. This is very noticeable along native paths during moonlight, and owing doubtless to some

peculiar chemotropic property in the odour of the natives, I have seen flies rabid with desire for food under these conditions.

With reference to the use in hospitals, spraying for flies and mosquitos was tried, but the discomfort to the patients, whom it was never possible to move during the operation, was such that the cure was worse than the nuisance.

In conclusion, when the main source of fly infestation, such as butcheries, hide drying sheds, and overflow sections of supplies, was removed to a sufficient distance from the main lines and the absolute cleanliness of all camps insisted on, the fly nuisance soon disappeared.

An important feature of fly control was the prevention of roads, leading near permanent camps, being used for stock and remount purposes, in Dar-es-Salaam, all such animals being stopped at the outskirts, as continual live stock traffic caused a daily reinfestation from far outlying sources, which greatly diminished the value of the work done to free from flies the areas of human habitation.

In this instance there was undoubtedly a good target on each animal, but as time and expediency in moving supplies was the main object, spraying was impracticable, even if means were available, and, as every porter was needed for carrying food and ammunition, out of the question further up the line.

Professor W. J. R. SIMPSON: I agree with Major AUSTEN and the other speakers that the most efficient method of dealing with the fly pest is to attack the flies in their larval stage and remove their breeding places. The sanitarian should pay chief attention to the prevention of the flies rather than to their destruction. When all that can be done in this direction of prevention is accomplished, my experience is that the spray is useful in getting rid of the discomfort and nuisance of the few stray flies that may enter the tent or hut. One's practice in Macedonia was to secure a fairly large area of ground around the hospital, so that passing regiments that were not very particular about sanitation could not encamp in too close proximity to the hospital

Colonel L. G. CUMMINS: I should like to ask, (1) whether any of the larger types of sprays, such as the "Vermorel," have been found useful in fly-destruction; (2) what means Major E. E. AUSTEN has employed to get a fine London fog-like mist of pyrethrum powder diffused through the air of rooms. I agree with Major AUSTEN that the best anti-fly measures were those directed against the breeding of flies.

Major AUSTEN: Colonel CUMMINS's question as to the means by which pyrethrum powder may be distributed through the air of rooms, so as to produce a fog-like mist, can be answered very simply. In default of small bellows of a special type, fitted with a tin container for the powder and purchasable in Rouen in 1915, a piece of muslin six or eight inches square will answer all requirements. All that is necessary is to ladle a few teaspoonfuls of the powder on to the centre of the muslin, screw up the latter with the hand so as to form a bag, and then, having first closed all doors and windows, to walk about the room shaking the bag until the desired effect is produced.

Surgeon-Captain P. W. BASSETT-SMITH, R.N.: May I draw attention to the fact that different circumstances alter very much the requirements of treatment. In the open and in the tropics the spray method of destroying flies might give but poor results, yet, speaking from a naval point of view, the method suggested by Professor LEFROY could be used with very great advantage in ships on those stations where flies are a veritable pest at certain seasons, chiefly in the Eastern Mediterranean, Persian Gulf, and Indian and Australian Ports. That the flies are a source of danger as carriers of disease on board is recognised, and many methods have been used more or less successfully to get rid of them, but none appear to have been very satisfactory. Formalin was the best.

Professor LEFROY: I agree with Major AUSTEN as to the value of fly-sprays in relation to the methods of dealing with flies in war areas. Sanitation is of the first importance. In Mesopotamia, the system of sanitation was one calculated to breed the maximum number of flies in the minimum time: a modification of this was the first necessity. Secondly, poisoning with sweetened sodium-arsenite was effective in Mesopotomia. I am not advocating fly-sprays, but am describing how they had been arrived at, and suggest that their use is limited really to hospitals and private houses, particularly in the tropics, also during the summer in fly-infested villages in England.

With regard to the use of powder as against the extract, the objections to the powder were the want of means of applying it, and the fact that the powder made the room dirty.

I would inform Col. BALFOUR that the castor oil is added only to the pyrethrum-safrol mixture. I have had no personal experience of the castor oil mixture in the tropics, but I have had two letters from Mesopotomia to the effect that the addition of the oil had made the spray effective.

"Osberol" is probably the spray referred to by Col. BALFOUR, and is claimed to be made to the formula of Mr. O'SULLIVAN BEARE. Cinol was believed to be a spirit infusion of pyrethrum made by Keatings.

In answer to Col CUMMINS, I may say that the small sprayer referred to was really an atomising device, and that ordinary sprayers do not atomise the liquids finely enough. A good atomiser for use on a large scale is needed.

The Chairman thanked the reader for his paper, and made a few appropriate remarks.

AN OUTBREAK OF ITCH DUE TO A PREDACEOUS MITE, OCCURRING IN ENGLAND AMONGST MEN ENGAGED IN UNLOADING COTTON SEED FROM EGYPT.

BY

F. W. O'CONNOR, M.R.C.S., L.R.C.P., D.T.M. & H. (Camb.).

London School of Tropical Medicine.

The outbreak described in this paper has been referred to by F. C. WILLCOX in his paper published in the *Agricultural Journal of Egypt*, 1915, where he also mentions the occurrence of three cases in Colchester about the same time. But the clinical condition or treatment of the London cases and the experimental work done were not known to the author, and I therefore take this opportunity of placing the facts before this Society.

Towards the end of November, 1913, I was requested to examine four men (stevedores) who refused to complete the unloading of cotton seed, imported from Alexandria in two ships, at the London Docks. Each man complained that, after having worked for about four hours at the cargo, he had become infected with an itch, which extended over his body, caused great irritation, necessitating constant scratching, and prevented him from sleeping at night. Two of the men further asserted that their wives—and one that his children as well—had been attacked by the itch. The men believed that these relatives, who had never been near the cargo, had been infected directly from the workmen themselves. None of the relatives, however, came forward for inspection.

On examination I found that each patient was suffering from an eruption of discrete character. In the worst case the rash extended, including the arms, from the neck to the ankles, while the same condition in patches of varying size, and in lesser degrees of severity, affected the other men. The hands and faces of all were unaffected, and the eruption in each case seemed to begin above the wrists or at the neck, because the papules were most numerous on the forearms and on the chest and upper part of the back.

In the early stages each spot was like a small blister; this soon became pink like a typical papule, which faded on pressure but which returned when the pressure was removed. The spots varied in size from a pin's head to a threepenny-piece. The rash shewed signs of fading where it had first begun, and it seemed more recent (blister-like), where it was undoubtedly spreading, farthest from the areas of early infection. The number and nature of the marks produced by scratching gave evidence of the severe degree of irritation caused.

The fact that the rash was fading in some localities while spreading in others, and that all cases were not equally affected, pointed to a local infection by some skin parasite rather than to a general blood infection; further, the non-inclusion of the head, neck and hands suggested a parasite requiring warmth. There was no constitutional disturbance. Blood examination revealed a slight increase in the number of eosophinile leucocytes; no other abnormality was found and no blood parasites were discovered. The men had suffered from the condition for forty-eight hours when I first saw them. I recommended hot baths, to be followed by sulphur inunction, and a change of clothing till the men's own clothes had been disinfected. After this treatment the irritation ceased, and the rash soon disappeared.

On examining the cargo nothing abnormal was seen on the surface of the cotton

seed, but through small holes in some of the seeds I noticed a small, pink, living maggot, and, on opening other shrivelled and apparently unhealthy seeds, I found similar maggots in the interior. I collected some of the seed and placed it in a warm room at the London School of Tropical Medicine. On microscopical examination I found creeping over some of the maggots a small mite, which was identified by Colonel ALCOCK as *Pediculoides ventricosus*. Macroscopically the mite could not at first be seen, but, on keeping, it multiplied rapidly, and each infected maggot became covered and obscured by a flour-like coating, somewhat resembling a mould, which consisted of masses of mites, amongst which large pregnant females could be distinguished with the naked eye. Some of the uninfected maggots were collected and kept separately by Colonel ALCOCK, and the adults which emerged were identified by J. HARTLEY DURRANT as *Gelechia gossypiella*.

I placed some of the mites in a watch-glass, which was then adjusted concavity downwards, against the skin of my forearm, and kept in position by adhesive strapping. After about six hours I began to experience marked irritation, and a few spots developed within the circumscribed area, identical in appearance with the spots which I had previously observed on the patients. No mites had been seen on the skin of the patients at my examination. Neither on them nor on myself could I see any signs of burrowing. The irritation and rash are, no doubt, caused by the bite of the insect, and, possibly, also by the numerous bristle-like hairs which protrude from its cuticle.

Since the above observations were made I have served in Egypt, and while at Alexandria I learned that the maggots of *Gelechia gossypiella* are parasites of the cotton plant and its seed in that country, and that an itch, similar to that which I have described, has on rare occasions occurred amongst the native cotton workers, especially the packers. Dr. M. SOROUR has informed me recently that though he knew of the existence of the mite, and the larva of *Gelechia gossypiella* in cotton seed yet he had never seen a case of itch which was attributed to the presence of the former.

The mite, *Pediculoides ventricosus* (NEWPORT), was first discovered at Gravesend, in Kent, where it was found to be parasitic on *Anthophora retusa*. It has since been found in other parts of England, in France, the United States, Mexico, and Egypt. It is known in these countries to be predaceous on many insects and their larvæ, especially on those of the latter which have soft cuticles. In Egypt it is recognised as a parasite of *Galechia gossypiella* (cotton seed moth) and *Galechia cerealella* (grain moth). It is known also to infect some insects found in straw. From an agricultural standpoint it is considered useful in assisting the control of insect pests injurious to grain and seed.

Our earliest information of infection of man by the mite comes from America, where, in an excellent paper by F. M. WEBSTER, the histories of several outbreaks of itch, so caused, are described. Some of these outbreaks occurred on a large scale.

The Tarsonemidae is a family of small mites, the females of which are recognised by the presence of a club-shaped appendage, which projects between the bases of the first and second legs on either side, and also by a pair of conspicuous airholes, or spiracles situated on the ventral surface, just in front of the first pair of legs.

The Tarsonemidae resemble other mites in the arrangement of the legs, the first and second pairs being arranged in juxtaposition to the head, and the third and fourth pairs far away near the hinder end of the body, and also in having long stalked terminal suckers on some of the legs; but the body is softer, and in the female it is not so squat.

Among the Tarsonemidae the genus Pediculoides is recognised by the very distinc head, formed chiefly by the curved and comparatively stout pedipalps.

The species *P. ventricosus* derives its name from the fact that in the pregnant female the lower part of the abdomen becomes swollen to form a large brood-sac. In the latter the embryos develop, and on hatching live within the mother and at her expense, without leaving the brood-sac until fully matured. Finally, they make their exit through the remains of the abdomen of the mother, which they have destroyed during their development.

As the mite is known to infect some of the parasites of straw and different kinds of grain in tropical countries, and as outbreaks of itch have been traced to its agency on several occasions in the United States, and now in this country, it would be well to bear

its existence in mind as a possible cause of itch occurring amongst people who work in straw or cotton seed, and amongst those who complain of a similar complaint after sleeping on newly-made straw mattresses.

I am indebted to Colonel A. Alcock for kind help and criticisms while I was preparing this paper.

REFERENCES.

1. Webster, F. M., United States Department of Agriculture (Bureau of Entomology), 1910, April 23rd.
2. Willcox, F. C., "The Predaceous mite *Pediculoides ventricosus* (Newport)." *Agric. Jl. of Egypt.* Cairo. No. I. June, 1914. Pp. 17-51.

DEMONSTRATION.

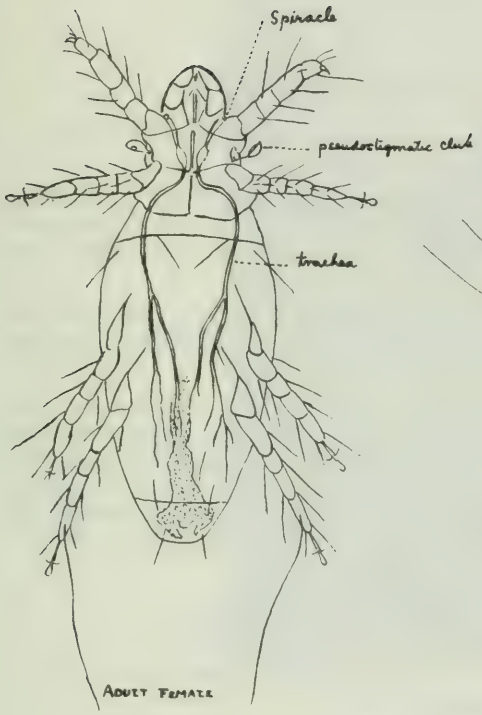
The following microscopical specimens, stained by the iron hæmatoxylin method after fixation in Schaudinn's fluid, were shewn by Dr. F. W. O'Connor :—

1. *Entamœba histolytica* cyst, containing 8 nuclei. The cyst measures 16·5 μ. The nuclei are typically those seen in *E. histolytica* cysts, with small central karyosomes and chromatin heaped in crescentic formation on the nuclear ring. The stool of the patient was examined on 44 occasions, and during this period no *E. coli* cysts were seen.

2. *E. coli*, free form, containing 2 lamblia cysts included in vacuoles.

3. *E. coli*, free form, with an *E. histolytica* cyst included. The cyst contains 4 nuclei and chromatoid bodies.

4. *E. coli*, free form, with an oöcyst of *Isospora hominis* included. The oöcyst measures 28 × 14 μ, and the ends bulge the amœba at opposite poles. In the fresh specimen 10 different *E. coli* were seen to possess a similar inclusion.


Spiracle
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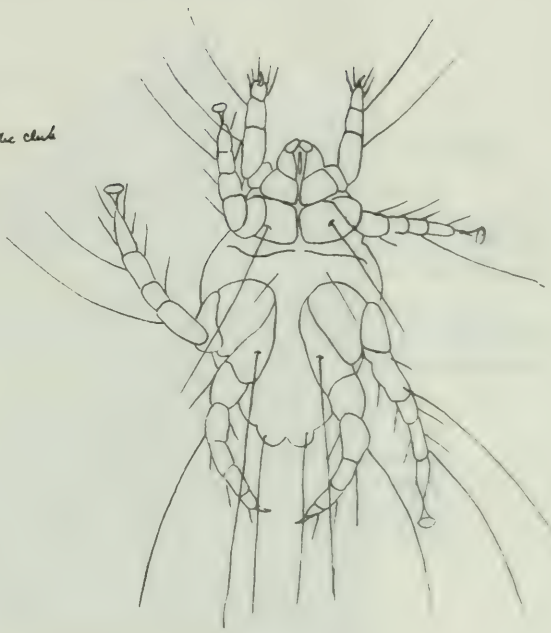
MALE.

CORRESPONDENCE.

Prestea, via Seccondee, West Africa, Gold Coast.

April 9th, 1919.

DEAR DR. LOW,

In the TRANSACTIONS of October 18th, 1918, under "Notes and Comments," I see that Major HUGH S. STANNUS has recorded some corrections. In the last paragraph but one he states, "I should like to add that rickets is unknown in all Central African races I have seen."

Until 1916 I should have agreed with him, but in that year I had a case which was of interest because it appeared to me to be rickets. The notes I then wrote about the case were as follows :—

> Belgian Congo, Kasai Basin, 1916.—Boy, aged about 12 years, deformed from his earliest memory. Typical rachitic rosary, pigeon breast, Harrison's groove. Lower limbs bowed, periosteal thickening, epiphyseal enlargements. Upper limbs, bones of forearm bent, irregular in outline, edges rounded, marked epiphyseal thickenings at ends of ulna and radius. General debility. Not as well built as boys of his age and height. No evidence of congenital syphilis.

Yours very sincerely,

W. E. MASTERS,

M.D. (Brux.), M.R.C.S.

The Secretaries, Society of Tropical Medicine,
11, Chandos Street, Cavendish Square, W. 1.

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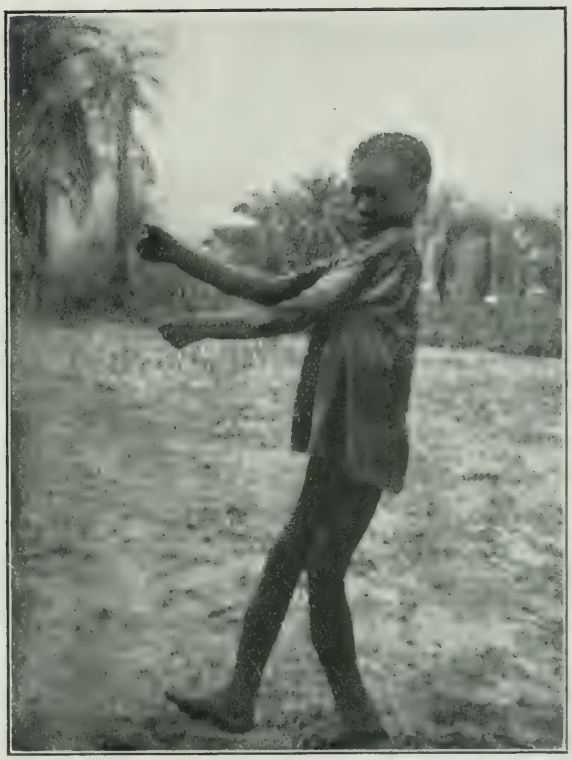

Case of Rickets in African Boy.